Asteroid Icy Regolith Excavation and Volatile Capture

Completed Technology Project (2015 - 2016)

Project Introduction

Icy regolith simulants will be produced in a relevant vacuum environment using various minerals, including hydrated minerals, that are found in C-type meteorites and in other types of planetary regolith. This will allow us to characterize the mechanical strength of the icy regolith as a function of ice content using penetration, excavation, and sample capture devices. The results of this study will benefit engineers in designing efficient regolith excavators and ISRU processing systems for future exploration missions to asteroids and other planetary bodies.

This study will help to inform engineers designing regolith excavators and ISRU processing systems for future exploration missions to asteroids and other planetary bodies. Icy regolith simulants will be produced in a relevant vacuum environment using various minerals, including hydrated minerals, that are found in C-type meteorites and in other types of planetary regolith. This will allow us to characterize the mechanical strength of the icy regolith as a function of ice content using penetration, excavation, and sample capture devices.

The project utilizes technologies developed under a FY14 project to excavate and measure the mechanical properties of icy regolith under relevant atmospheric conditions . The earlier project tested icy regolith using a 1/8 scale test setup and also developed a full-scale test system for regolith excavation, sample capture and soil mechanics studies. Technical challenges include preparing icy regolith at cryogenic temperatures inside a vacuum chamber, and controlling the environmental conditions, i.e., low temperature and high-vacuum pressure.

Key project objectives:

Use the novel methods developed under an earlier project that produced mixtures of ice and lunar (or Martian) regolith simulant under low pressure in an existing laboratory vacuum chamber at KSC. In this project, we will use other planetary regolith simulants including BP-1 and especially asteroid simulants that will be developed in collaboration with the University of Central Florida's Center for Lunar and Asteroid Surface Science (CLASS) which is a member of NASA's Solar System Exploration Research Virtual Institute (SSERVI).

Use the Regolith Excavation and Soil Mechanics Test System developed under the previous project to measure penetration and excavation forces on a full scale system, and to test a sample capture device.

Anticipated Benefits

This project fundamentally changes NASA’s ability to understand the soil mechanics and the forces required to drill, sample, and excavate icy regolith in a relevant environment.

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Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Independent Research & Development: KSC IRAD

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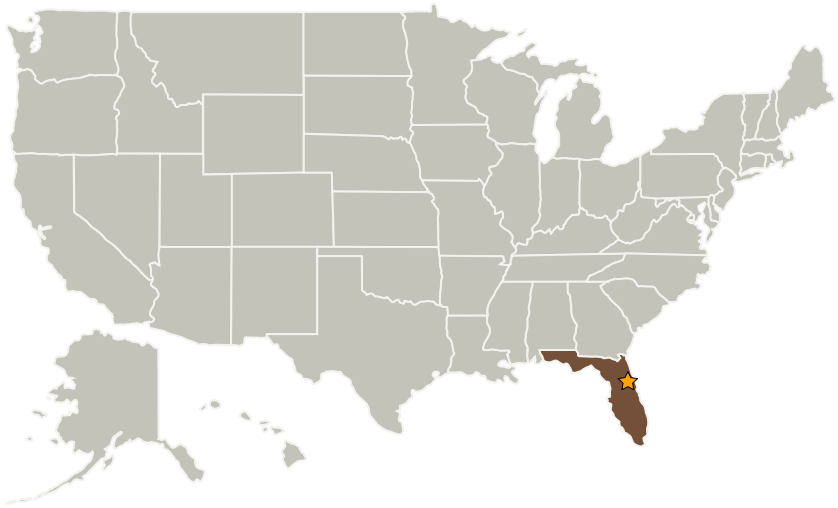
NASA's Return on Investment: NASA's technology development for icy planetary surface missions cannot be completed without this new capability. The results will enable the acceleration of technological know-how and science related to planetary icy regolith and will result in state-of-the-art capabilities for NASA and outside customers.

Non-NASA benefits – (commercial applications, etc.)

The rapid emergence of commercial ventures aimed at exploiting space resources creates potential users of the new capabilities and the related technologies.

The technology will benefit the future commercial space mining community with designing efficient regolith excavators and drilling technologies for use on asteroids and other planetary bodies.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida

Project Management

Program Manager:

Barbara L Brown

Project Manager:

Nancy P Zeitlin

Principal Investigator:

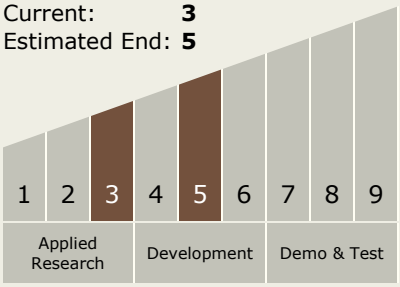
James G Mantovani

Co-Investigators:

Ivan I Townsend
Adam M Swanger

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **5**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.1 Destination Reconnaissance and Resource Assessment

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Primary U.S. Work Locations
Florida

Links

KSC-13933
(no url provided)

KSC-13934
(no url provided)